REPORT DOCUMENTATION PA

AD-A253 232

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
		FINAL 01 Aug 88 TO 31 Dec 91

4. TITLE AND SUBTITLE

SELF-CONSISTENT MODELLING OF THE IONOSPHERE-THERMOSPHERE-MAGNETOSPHERE SYSTEM

5. FUNDING NUMBERS

C - F49620-88-C-0111
PE - 61102F
PR - 2310
TA - A2

6. AUTHOR(S)

Dr Jeffrey M. Forbes

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Boston University
College of Engineering
110 Cummington Street
Dept of Aerospace and Mechanical Engineering
Boston, MA 02215

8. PERFORMING ORGANIZATION REPORT NUMBER

92 0191

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

Lt Col James G. Stobie
AFOSR/NL
Building 410
Bolling AFB DC 20332-6448

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release;
Distribution unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

One of the most significant results to emerge from this contract is the systems theory approach to thermospheric dynamics which was developed as part of the Dissertation research of Mihail Codrescu, a Ph.D. student supported by AFOSR. The basic components of the computational approach are a piecewise linearization method capable of preserving nonlinear features of a dynamical system (in this case, the NCAR TIGCM), and a response function "library" consisting of quasi-steady state and sample response functions characteristic of the system. A typical usage would be approximating the dynamical thermospheric response to an arbitrary change in forcing by performing a specialized convolution between the specified forcing and an appropriate set of response functions from the "library". This methodology may provide the basis for computationally efficient real-time (operational) predictions without on-line use of a TIGCM.

14. SUBJECT TERMS			15. NUMBER OF PAGES
			16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT (U)	18. SECURITY CLASSIFICATION OF THIS PAGE (U)	19. SECURITY CLASSIFICATION OF ABSTRACT (U)	20. LIMITATION OF ABSTRACT (U)

FINAL TECHNICAL REPORT

AFOSR Contract F49620-88-C-0111

entitled

SELF-CONSISTENT MODELING OF THE IONOSPHERE-THERMOSPHERE-MAGNETOSPHERE SYSTEM

31 May 1992

Prof. Jeffrey M. Forbes, Principal Investigator
Center for Space Physics and
Department of Aerospace and Mechanical Engineering
Boston University, Boston, MA 02215

1. OVERVIEW

The main focus of research under Contract F49620-88-C-0111 (1 Aug 1988 - 31 Dec 1991) entitled "Self-Consistent Modeling of the Ionosphere-Thermosphere-Magnetosphere System" was to better understand the interactions between the ionosphere, thermosphere, and magnetosphere systems through the use of self-consistent mechanistic models and analyses of data, with a view towards developing parameterizations for these interactions which will provide significantly improved and more efficient predictive capabilities. These overall goals have been satisfied, and are embodied in the publications and presentations listed in the following sections. All of the reprints and preprints corresponding to the following manuscripts have been forwarded to AFOSR/NC.

2. PUBLISHED PAPERS AND MANUSCRIPTS IN PRESS

[1.] Observations of neutral circulation at mid-latitudes during the equinox transition study, M.J. Buonsanto, J.E. Salah, K.L. Miller, W.L. Oliver, and R.G. Burnside, J. Geophys. Res., 94, 16987-16997, 1989.

[2.] Thermosphere-ionosphere coupling: an experiment in interactive modeling, J.M. Forbes and R.G. Roble, J. Geophys. Res., 95, 201-208, 1990.

[3.] Thermospheric dynamics: a system theory approach, M. Codrescu, J.M. Forbes, and R.G. Roble, Radio Sci., 25, 299-308, 1990.

[4.] Neutral and ion composition changes in the F region over Millstone Hill during the equinox transition study, W.L. Oliver, J. Geophys. Res., 95, 4129-4134, 1990.

[5.] A numerical investigation of thermosphere-ionosphere interaction over Millstone Hill, M.E. Hagan, J.M. Forbes, and M. Codrescu, Planet. Space Sci., 38, 1541-1549, 1990.

[6.] Simulation of a gravity wave over the MU radar, W.L. Oliver and M.E. Hagan, J. Geophys. Res., in press, 1991.

[7.] Coupling parameterizations in magnetosphere-ionosphere-thermosphere modeling, J.M. Forbes, D.N. Anderson, I. Batista, L. Carter, M. Codrescu, and R. Roble, Adv. Space Res., 12(6), 293-301, 1992.

[8.] Interactive ionosphere modeling: a comparison between TIGCM and ionosonde data, M. Codrescu, R.G. Roble, and J.M. Forbes, in press, J. Geophys. Res., 1992.

3. PRESENTATIONS

[1.] A numerical study of upper atmospheric and ionospheric interaction over Millstone Hill, M. Hagan, J. Forbes, and M. Codrescu, fall meeting of the AGU, San Francisco, December, 1988.

[2.] F-region ion and neutral composition changes during the ETS period, W.L. Oliver, fall meeting of the AGU, San Francisco, December, 1988.

[3.] Simulation of a gravity wave over the MU radar, W.L. Oliver and M.E. Hagan, fall meeting of the AGU, San Francisco, December, 1988.

[4.] Observations of neutral circulation at midlatitudes during the equinox transition study, M.J. Buonsanto et al., fall meeting of the AGU, December, 1988.

[5.] Latitudinal penetration of geomagnetic storm effects: a comparison between TIGCM and ionosonde data, M. Codrescu et al., spring meeting of the AGU, Baltimore, 1989.

[6.] Time-dependent modeling of the ionosphere with the Thermosphere-Ionosphere General Circulation Models, M. Codrescu et al., Cospar Meeting, The Hague, Netherlands, July, 1990.

[7.] Thermospheric dynamics: a system theory approach, M. Codrescu et al., fall meeting of the AGU, San Francisco, 1989.

[8.] Coupling parameterizations in magnetosphere-ionosphere-thermosphere modeling, J.M. Forbes et al., Cospar Meeting, The Hague, Netherlands, July, 1990.

4. SIGNIFICANCE OF RESULTS

One of the most significant results to emerge from this contract is the systems theory approach to thermospheric dynamics which was developed as part of the Dissertation research of Mihail Codrescu, a Ph.D. student supported by AFOSR. Besides Mr. Codrescu's Dissertation, this work appeared in publication number 3 of the list provided in Section 2. The basic components of the computational approach are a piecewise linearization method capable of preserving nonlinear features of a dynamical system (in this case, the NCAR TIGCM), and a response function "library" consisting of quasi-steady state and sample response functions characteristic of the system. A typical usage would be approximating the dynamical thermospheric response to an arbitrary change in forcing by performing a specialized convolution between the specified forcing and an appropriate set of response functions

from the "library". This methodology may provide the basis for computationally efficient real-time (operational) predictions without on-line use of a TIGCM.

Another significant accomplishment of this contract was the development and evaluation of several coupling parameterizations with potential application in magnetosphere-ionosphere-thermosphere modeling. Such parameterizations were derived for low, middle, and high-latitude applications, and are described in publications 2,5,7 and 8 of Section 2. The goals of this work were to (a) better understand atmosphere-ionosphere interactions, and (b) to derive simple analytic relationships between characteristic fields of the ionosphere and thermosphere systems. The methodology involved experiments using comprehensive numerical models and utilizing fitting methods to establish analytic relationships. Potential applications of this work are anticipated in transitioning current predictive numerical models to the operational environment.

5. PERSONNEL

Personnel supported under this grant included:

[1.] Prof. Jeffrey M. Forbes, Principal Investigator

[2.] Prof. William Oliver, faculty Co-Investigator

[3.] Mr. Mihail Codrescu, Ph.D. Student. Mr. Codrescu's Dissertation was entitled "Thermospheric Dynamics: A Systems Theory Approach". He was awarded the Ph.D. in Engineering in 1990.